A Doppler Radar/Spectrometer for Characterization of Gas and Dust on Primitive Bodies and Icy Moons

Completed Technology Project (2015 - 2017)

Project Introduction

We propose to build the first particle and gas remote sensing instrument that combines three functions in one: an 86-90 GHz radar and two tunable spectrometers covering the 179-196 and 545-580 GHz bands. Dubbed GAISR (Gas And Ice Spectrometer Radar) for its ability to monitor geyser-like phenomena in space, the instrument will be designed to probe the composition, dynamics, and interactions of particles and gases in cometary jets (and, secondarily, in plumes of icy moons). GAISR's radar will measure the range-resolved backscattering and velocities of ensembles of 0.1 mm and greater sized jet particles, while its spectrometers will simultaneously measure the molecular composition, abundance, and velocity of jet gases. To build GAISR, we will integrate state-of-the-art TRL-4 millimeter and submillimeter (mm and submm) wavelength components into a flight-like, environmentally tested assembly with an exit TRL of 6. By sharing back-end RF and digital subsystems, as well as front-end packaging and a common conical-scanning antenna, GAISR's three-in-one radar/spectrometer architecture will leverage synergies between the separate functionalities to save mass and power compared to separately developed instrumentation. Meanwhile, GAISR's capability of detecting small particles over appreciable distances, and its ability to measure the coupling between gas and particles, will enable new science measurements of jet activity in the solar system. At the conclusion of this effort, a flight-like, TRL-6 prototype instrument will be available to be implemented in future NASA announcements of opportunities. The most relevant flight insertion opportunities for GAISR are the New Frontiers concept for a Comet Surface Sample Return (CSSR) mission and other Discovery-class or future Flagship missions to comets. CSSR has been recommended by the NRC's 2012-2013 Planetary Science Decadal Survey to be carried out by 2022. The CSSR landing craft can be equipped with GAISR to provide unprecedented data during the approach phase on the particle distribution and velocity close to the comet's nucleus, and the dynamics of its coupling to outgassing molecules. Far from the comet, GAISR would also function as a widely tunable spectrometer, similar to the MIRO instrument on Rosetta, to probe the molecular composition and thermal properties of the comet with exquisite sensitivity. Additional potential mission insertion possibilities include the Life Investigation For Enceladus (LIFE) sample-return mission to Enceladus, or a plume-oriented mission to Europa or Ceres.

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Organizational Responsibility

Responsible Mission Directorate:

Science Mission Directorate (SMD)

Responsible Program:

Maturation of Instruments for Solar System Exploration

A Doppler Radar/Spectrometer for Characterization of Gas and Dust on Primitive Bodies and Icy Moons

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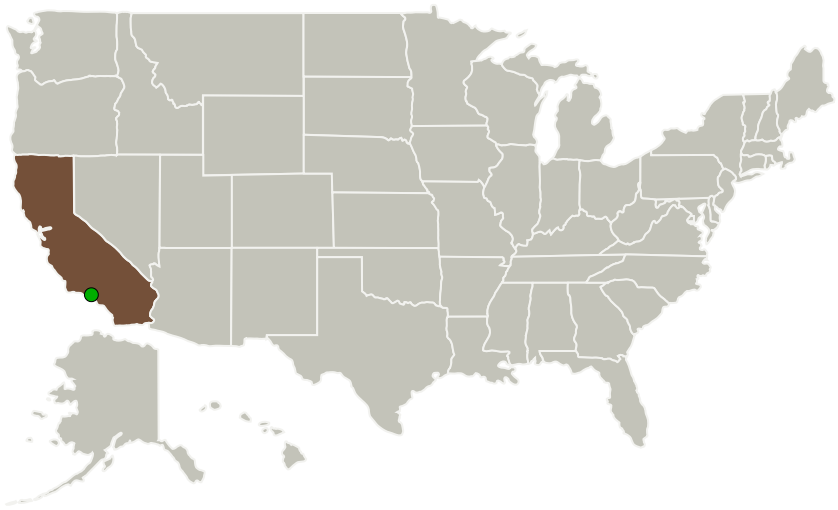
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
Jet Propulsion Laboratory(JPL)	Supporting Organization	NASA Center	Pasadena, California

Primary U.S. Work Locations
California

Project Management

Program Director:

Carolyn R Mercer

Program Manager:

Haris Riris

Principal Investigator:

Kenneth B Cooper

Co-Investigators:

Stephen Durden
Anders Skalare
Adrian J Tang
Imran Mehdi
Mathieu N Choukroun
Goutam Chattopadhyay
Karen R Piggee

Technology Areas

Primary:

- TX08 Sensors and Instruments
  - TX08.1 Remote Sensing Instruments/Sensors
    - TX08.1.4 Microwave, Millimeter-, and Submillimeter-Waves

Target Destination

Others Inside the Solar System